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SEASONAL CHANGES IN TOTAL CONTENT OF SOLUBLE CARBOHYDRATES IN EVER-GREEN PLANTS

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Abstract

A comparative study on the total seasonal content of the soluble carbohydrates in three ever-green species did not indicate any decisive correlation among the seasonal content of these metabolites, dry organic matter and chlorophyll content on a seasonal basis. The seasonal content of the soluble metabolites was found to be higher in a short-day-photoperiod in the case of two broad leaved-species but in *Taxus baccata* this principle was found lacking due to a further drop in autumnal values. The lowest summer level of the soluble carbohydrate content was found to be in contrast to the high summer-grading of the chlorophylls in all three ever-green species. A gradual fall in level of such metabolites during the long-day-photoperiod indicates that availabity of these metabolites not only depends on the amount of chlorophyll and increased photosynthesis but on some other factors-viz increase in rate of respiration lowers the level of soluble carbohydrates.

Introduction

The subject material of this paper forms a section of an extensive work the theme "Seasonal changes in the level of photosynthetic pigments and soluble carbohydrates in ever-green plants". The quantitative investigations on the seasonal content of soluble carbohydrates were carried out with a view to finding out (1) the general trend of such metabolites in ever-green plants in response to the changing conditions on a seasonal basis and (2) whether there exists any correlation among the seasonal variation in the total content of the soluble carbohydrates, dry organic matter and chlorophyll content.

The investigations on a quantitative basis were carried out on three selected ever-green plants: *Taxus baccata* L., *Laurocerasus officinalis* ROEM and *Hedera helix* L. The experiments were restricted to the leaf production of spring 1973 only. The epxerimental work started in January 1974 and ended in November 1975, thus including almost the whole seasonal cycle of the year.

Experimental

Only a small quantity of the fresh leaf-material, 0,1—0,5 g in the case of broad-leaved species and 0,3—0,6 g for *Taxus baccata*, was used as experimental samples. After the pigment extraction using a method suggested by MARÓTI and GABNAI (1971), the residues of the leaf-samples which contained soluble carbohydrates were put in to the graduated bioling flasks by repeated washing with a little dist. water. The sol. was adjusted to a suitable concentration (1 Lit). which could later on be convenient in absorbance measurement.

The volumetric and calorimetric procedures were followed as suggested by Dubois et al (1956) and the use of a spekol spectrophotometer with a two cell arrangement at 490 nm was made for the specific extinction of the solution, so obtained.

The quantitative determination in terms of soluble carbohydrates γ/g dry organic matter was made possible by the help of absorbance measurement (specific extinctions) and a previously decided curve, also suggested in published literature. About 52 experiments for each plant, in each season, were performed and averages in terms of soluble carbohydrates γ/g dry organic matter were evaluated from the recorded experimental data.

Results and discussions

From the absolute values on a seasonal basis, it was found that the highest content of the total of soluble carbohydrates was maintained in winter in all three ever-green plants under investigation (table 1). The highest winter level of soluble carbohydrate content was maintained in positive correlation of the dry organic matter g/100 dm^2 leaf-area for the period when the chlorophyll content was found to be in second place to the summer maxima (described else-where). KULL and BRACKLE (1972) reported that the winter maxima in the leaves of *Quercus* balout, an ever-green tree species, was maintained due to the presence of sorbitol in that season. The fall in level of such metabolites occured in all cases with a spring fall in two other leaf-materials, as mentioned. LITTLE and LOACH (1972) also reported the spring fall in sugar content of 1-year old leaves of *Abies balsamea*.

These authors, with reference to ALDEN and HERMANN (1971), believed that the spring fall in the level of total sugar content was the result of a protective mechanism against injury from low temperature in early spring. Such on assumption could not be tenable on the basis of our present results because the summer values dropped further in comparison to those of spring.

Table 1. Average seasonal values of the total content of soluble carbohydrates γ/g and chls mg/100 g — dry leaf-material

Plant species	Winter		Spring		Summer		Autumn	
	Chls.	Sol. carbo-hydrates	Chls.	Sol. carbo-hydrates	Chls.	Sol. carbo-hydrates	Chls.	Sol. carbo-hydrates
T. baccata	283,7	138,0	246,1	131,7	331,8	109,6	320,1	99,1
L. offic.	196,4	134,0	187,7	107,2	224,1	92,6	197,8	102,7
H. helix	323,0	194,9	285,0	126,3	331,7	92,2	328,0	163,0

The summer fall in soluble carbohydrate content occurred in a negative trend to the summer maxima of the chlorophylls in all the three species. Nevertheless, the progress in dry organic weight g/dm^2 leaf area was noted for this period in the case of two sunny plants, *Taxus baccata* and *Laurocerasus officinalis* but fell short of the values for the winter. The summer decrease in the level of soluble carbohydrates in the case of *Hedera helix* agreed in absolute terms with its dry ogranic weight g/dm^2 leaf-area for that period. It therefore seems that the fall in level of soluble carbohydrates during the period of plant activity (spring and summer) is connected to the incre-

ased respiratory mechanism in addition to some other unknown physiological process and not only due to the protective mechanism against injury caused by frost of in early spring.

Regarding the autumnal values, a clear tendency to increase is visible up to the winter up-grading in the case of two broad-leaved species, *Laurocerasus officinalis* and *Hedera helix*. The age factor (1,5 year old leaves) seems to be ineffective in these cases. In *Taxus baccata*, no sign of recovery in autumnal values is visible. It is not known whether the autumnal fall in the case of *Taxus baccata* is connected with the age factor (1,5 year) of the leaves or with some other physiological phenomenon. Nevertheless, in the light of overall seasonal values it can be generalized that in two ever-green broad-leaved species, the total content of soluble carbohydrates for the short day photoperiod were found to be higher than for the long-day photoperiod, where as this tendency is lacking in the case of *Taxus baccata*.

References

ALDEN, T. R. and HERMANN: (1971) Effect of cold-hardiness mechanism in plants. Bot. Rev. *37*, 37—142.

DUBOIS, M., GILLES, K. A., HAMILTON, T. K., REBERS, P. A. and SMITH, F.: (1956) Calorimetric method for determination of sugars and related substances. — Anal. Chem. *28*, 350—356.

KULL, V. U. and BRACKLE, S. W.: (1972) Annual changes in ostomic conditions and carbohydrate content in East Afghanistan — Trees Flora *161*, 586—603.

LITTLE, C. H. A. and LOACH, K.: (1972) Effect of changes in carbohydrates concentration on the rate of net photosynthesis in Mature leaves of Abies Balsamea. — Can. J. Bot. 51, 751—758.

MARÓTI, I. and GABNAI, E.: (1971) Separation of chlorophylls and carotenoids by thin layer Chromatography. — Acta. Biol. Szeged *18*, 71—80.

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